WELCOME TO PHYC 306L
Contemporary Electronics

Fall Semester 2017

Instructor: Dr Michael Hasselbeck

WHAT IS THIS COURSE ABOUT?

Practical, hands-on experience with electrical circuits, electronics, and instrumentation

LabView: Data-flow programming with National Instruments popular software package

HOW THE COURSE WILL WORK

10 minute quiz at the start of each class. Quiz will test concepts from previous week.

45 minute lecture introducing material for the current lab; LabView instruction

Remaining time for doing the experiments

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GRADING:

50%: Weekly quiz scores (2 dropped; no makeup quizzes)

25%: Lab projects, reports, notebook (1 dropped, no makeups)

25%: Labview projects (1 dropped, no makeups)

No exams

Electronics Projects

Labs are designed to be completed in one session

Students work in teams of 2, but collaboration with everyone is encouraged

Teams change each week

Report writing will be minimal. Keep a notebook. Show your work to instructor as you progress through the project.

Some analysis will be required. Email reports to instructor BEFORE class.

Data-flow programming for implementing virtual instruments (VI)

Wide variety of freely available tutorials: videos, manuals, examples

Weekly projects. Due BEFORE class starts! Come to my office anytime before noon Monday and demonstrate your VI. Monday reviews must reserve a 10 min time slot.

Work alone or collaborate. Each student responsible for producing, demonstrating, and understanding the assigned VI

Where to get it?

UNM has a site license; see me for install procedure

Installed on computers in Jr Lab (PandA 133)

ECE student computer pods

Purchase from National Instruments: $20

I'm a Physics major! Why are they making me take an *ECE course ???*

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- This is not an ECE course
- ECE and Physics overlap more than most other STEM disciplines
- Learn instrumentation and techniques that will be needed in 307L and 493L
- Harmonic analysis: Powerful tool for advanced physics courses
- LabVIEW is a marketable skill: academic, government, industrial research labs
- This course is a common component of undergrad curriculum at many other P&A departments

Short biography of the Instructor:

1981 BSEE (SUNY-Buffalo)

1983 MSEE (SUNY-Buffalo)

1984--1992 California aerospace industry

1995 PhD ECE (CREOL/Univ of Central Florida)

1996 Postdoc (AFRL Kirtland AFB)

1997—1998 Humboldt research fellow (Max Born Institute, Berlin, Germany)

1998—2001 Research scientist (AFRL Kirtland AFB)

2001—2010 Research professor (UNM PandA)

2010—2011 Guest professor (Uni-Konstanz, Germany)

2012—present Staff scientist (UNM PandA)

PROS:

Data-flow programming: Parallel execution of code

Graphical: Easy to learn, even for non-programmers; Drag-and-drop icons

Vast library of example code available

Readily integrates with NI hardware and many other vendors

All popular data buses supported (GPIB, PCI, ethernet, USB, wireless...)

Executables can be generated: Use on computers without LabVIEW

CONS:

Proprietary software from National Instruments

No independent standards

Licensing fees ($$$)

Works best on Windows. Less capable on Mac-OSX and Linux

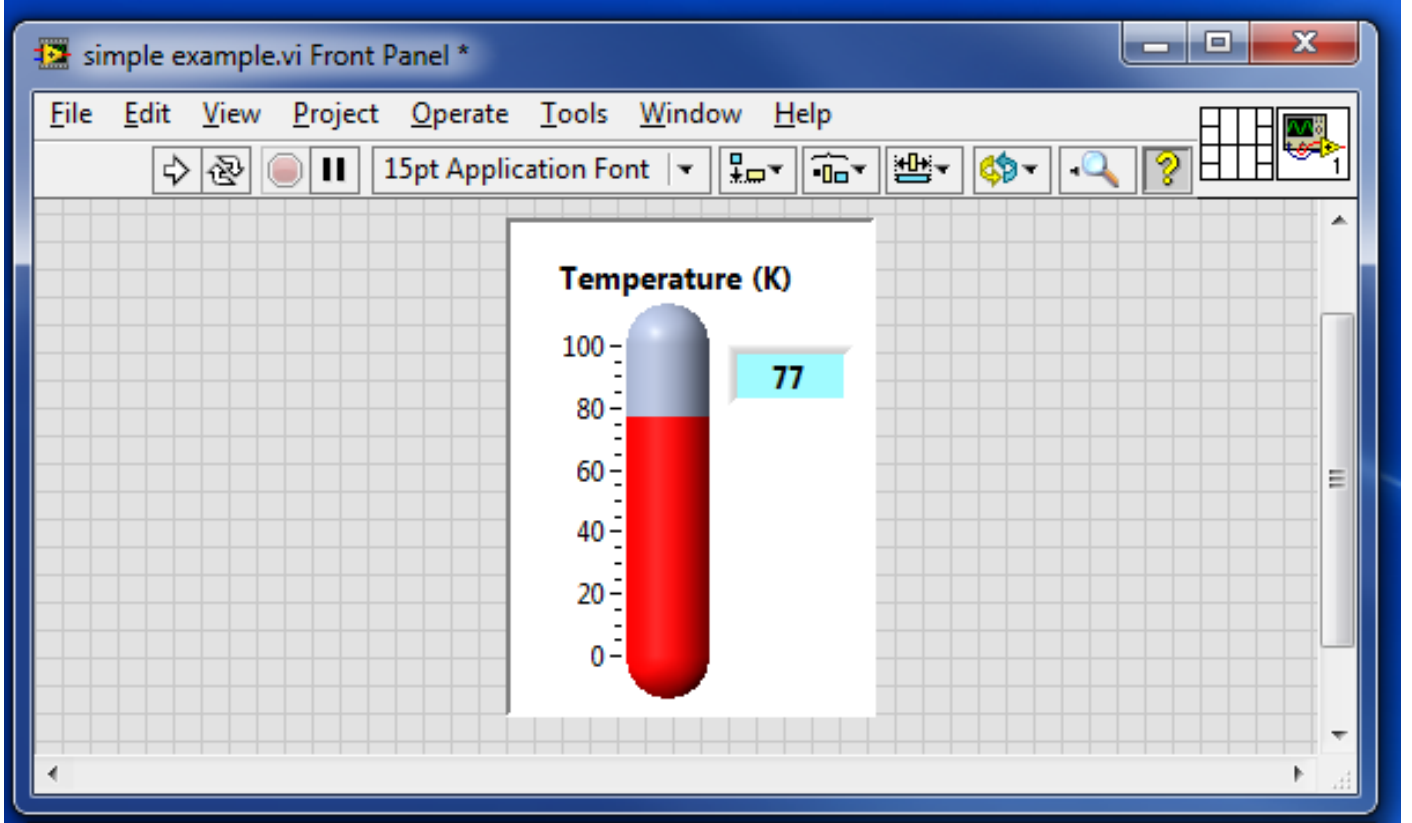
Large applications require high expertise; resource management

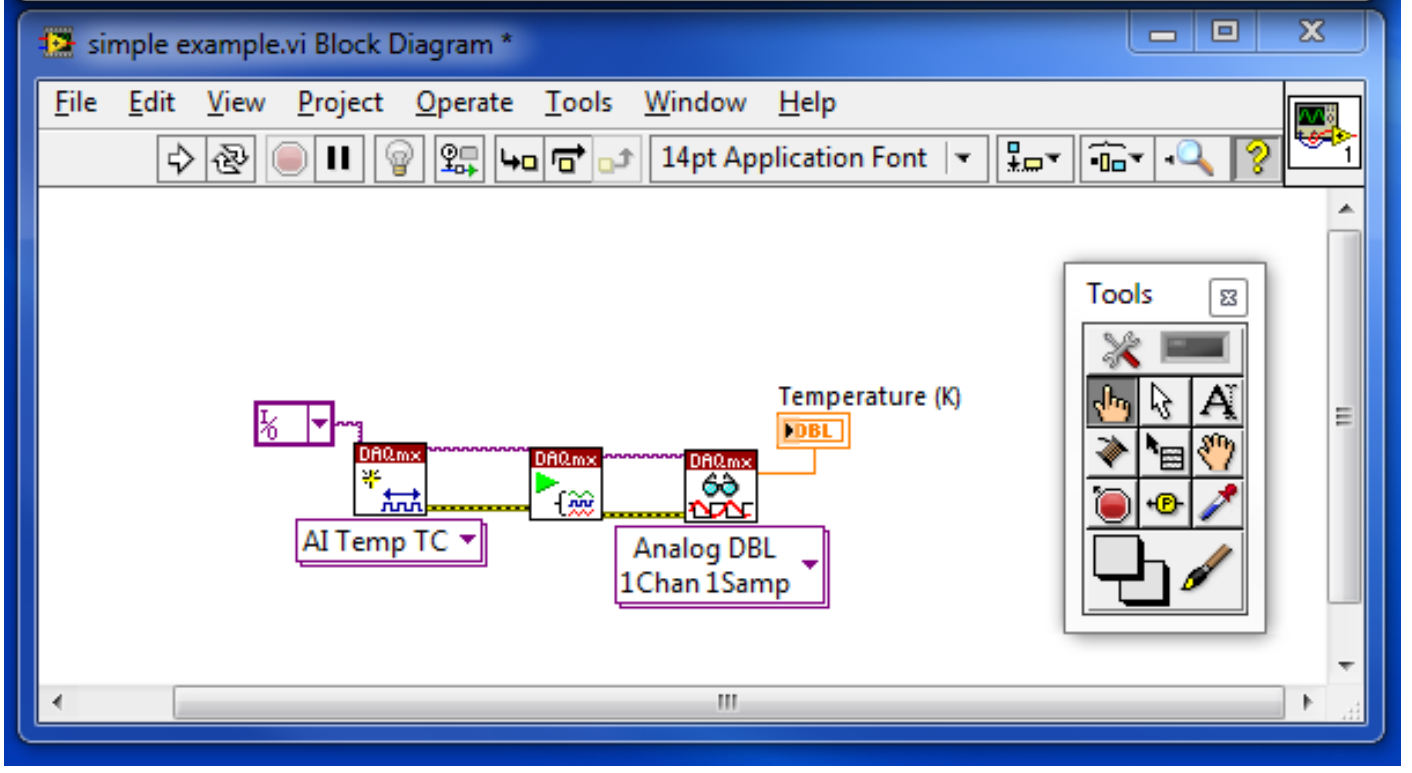
Generally slower than text-based code

Building stand-alone executables requires
Professional Development System (more $$$)

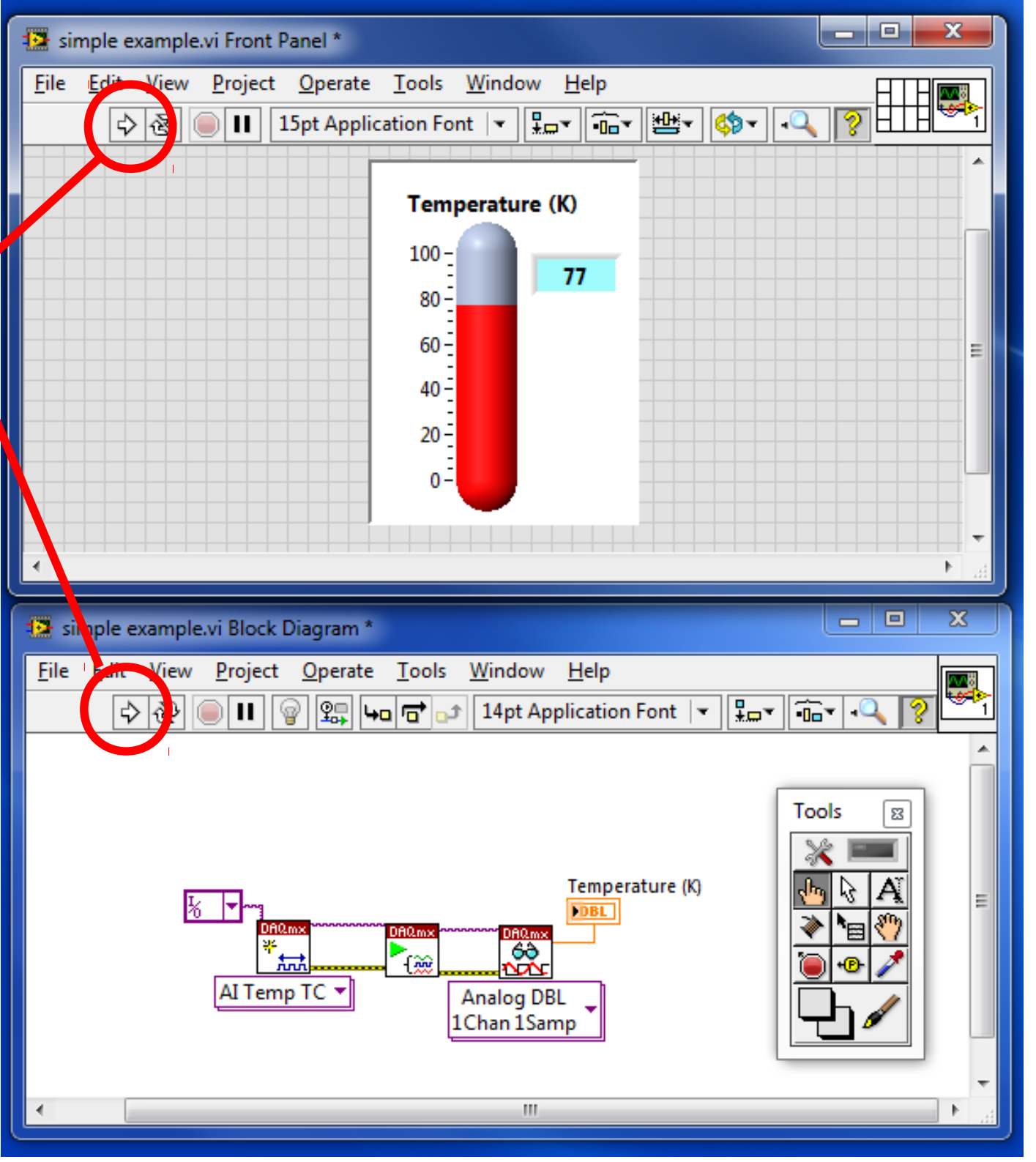
FRONT PANEL

BLOCK DIAGRAM





Run the VI


simple example.vi Front Panel *
File Edit View Project Operate Tools Window Help
15pt Application Font
Temperature (K)
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simple example.vi Block Diagram *
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Tools
Temperature (K)
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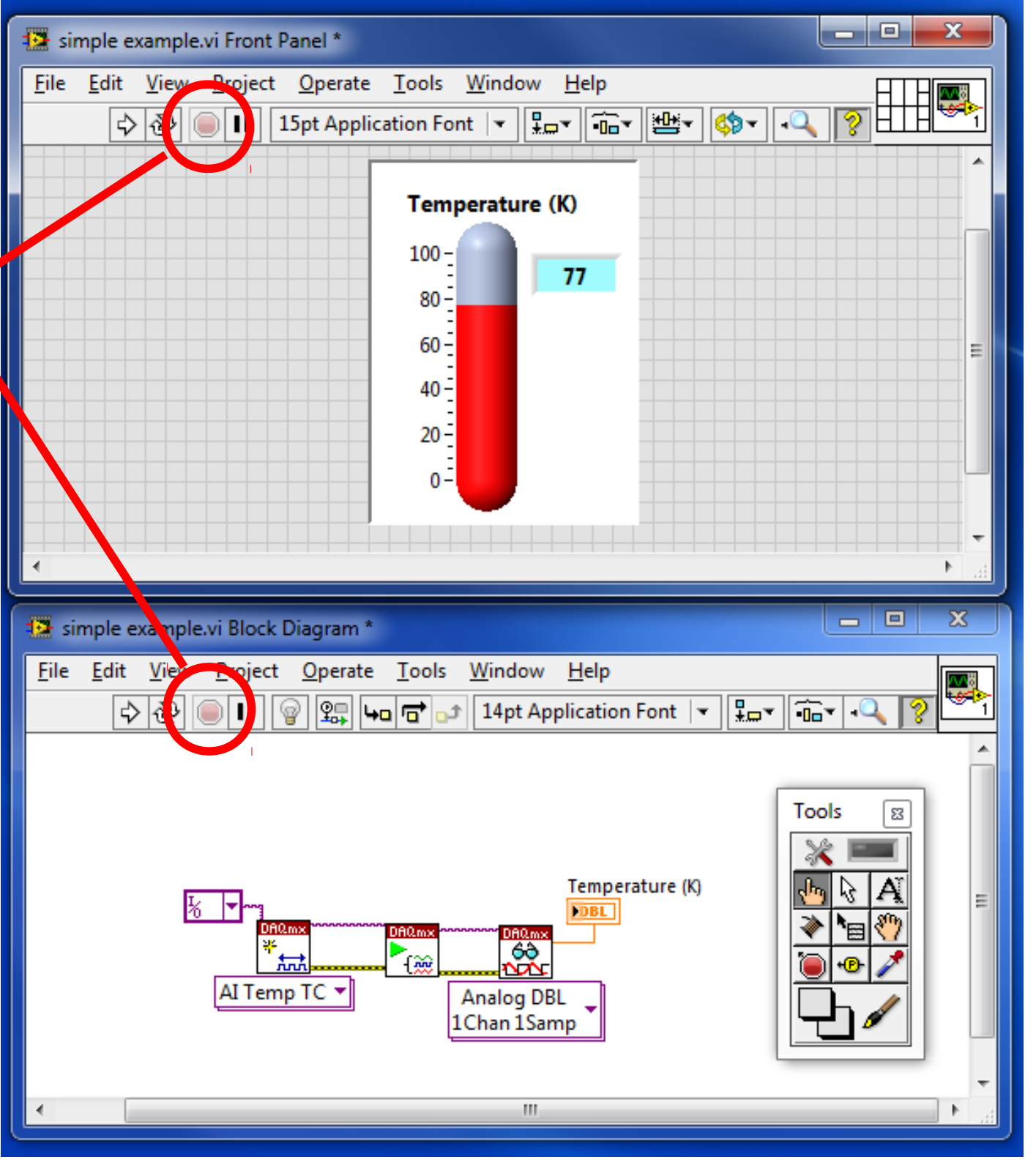
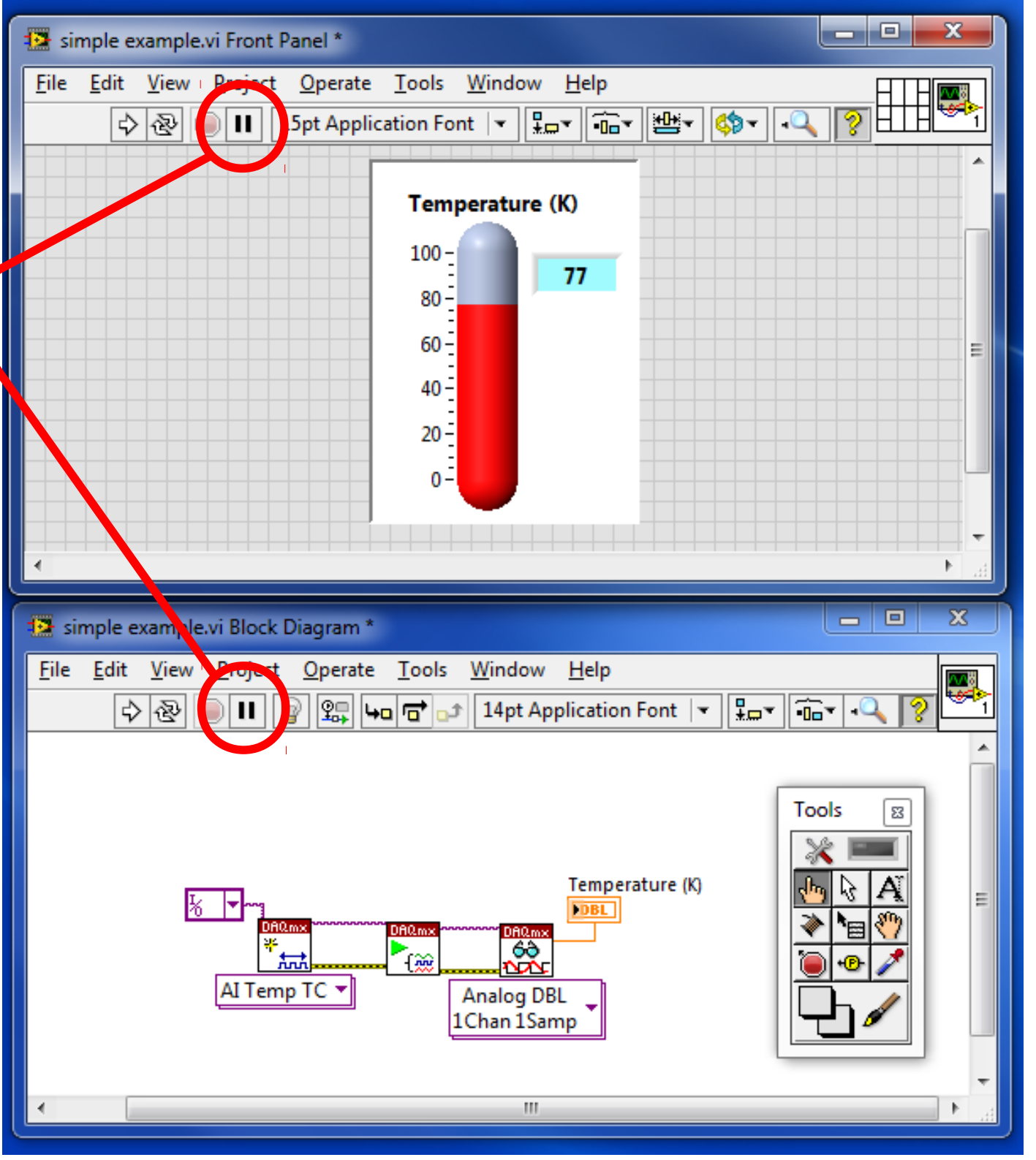
DAQmx
AI Temp TC
Analog DBL
1Chan 1Samp

Abort the VI*

* Use this only when all else fails



Pause the VI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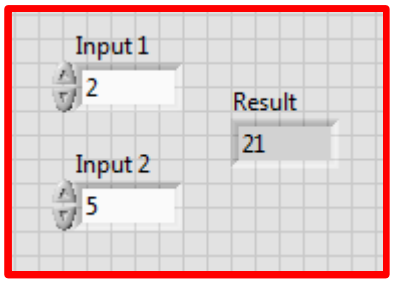
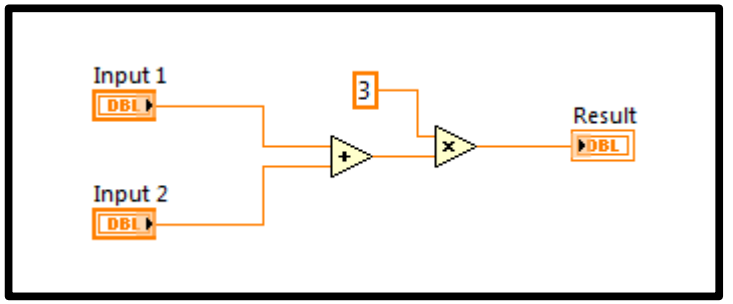
Data-flow programming on the Block Diagram

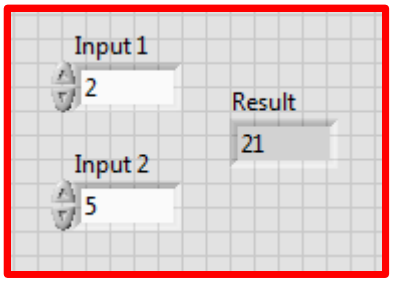
Code does not execute left-to-right

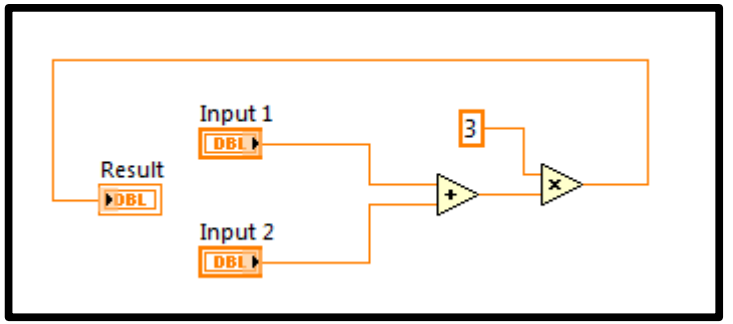
Nodes execute depending on availability of data at input terminals

These two VIs are operationally identical:









Setting up Block Diagram to flow left-to-right can help visualize logical flow

Description of Tools Palette

Description of Tools Palette

Operate Value

Interact with working VI primarily from Front Panel

Description of Tools Palette

Position/Size/Select

Used on both Front Panel and Block Diagram

Opens pop-up menus with right-click

Description of Tools Palette

Edit Text

Works like a word-processor cursor

Description of Tools Palette

Connect Wire

Connects icons and objects on the Block Diagram

Handy keyboard shortcuts

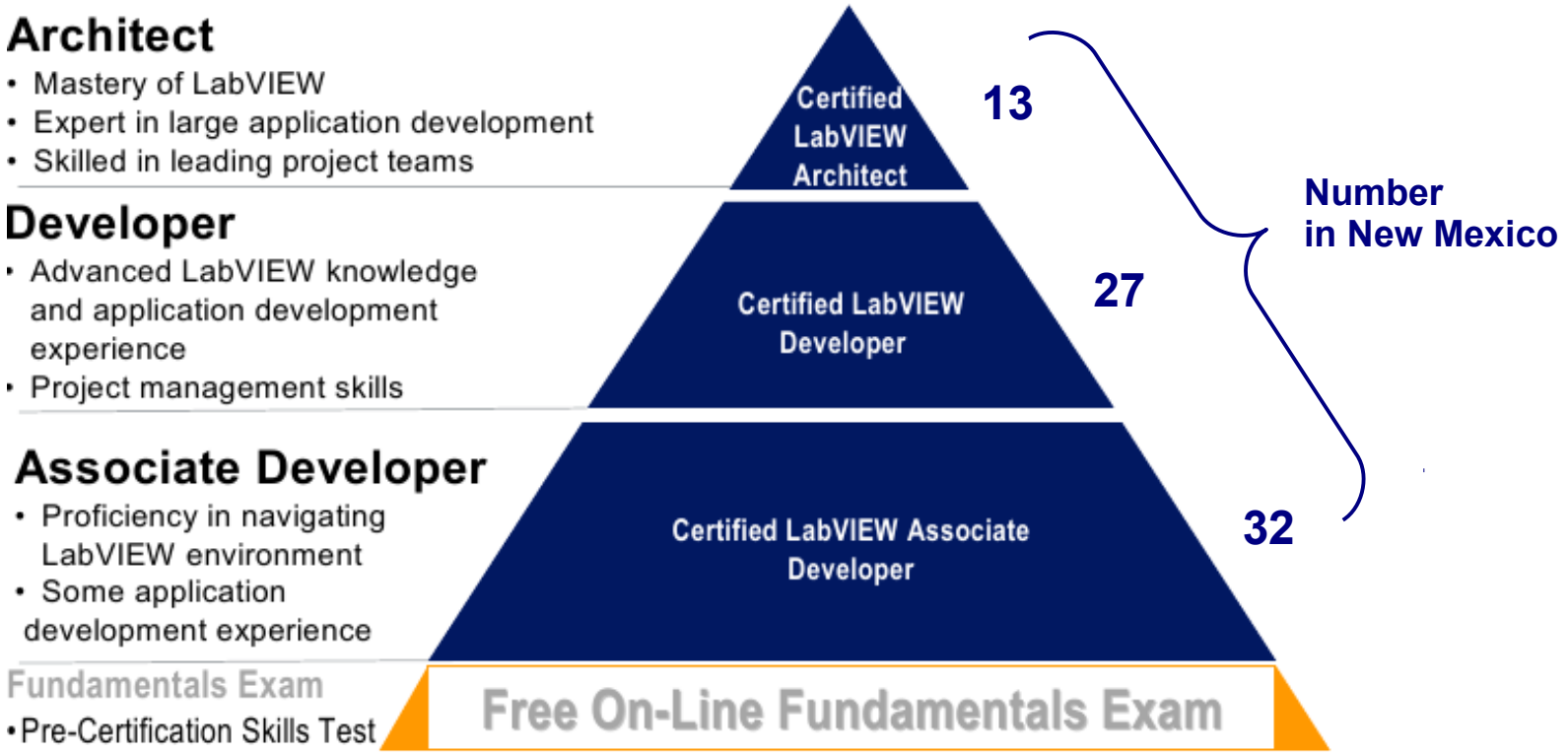
CTRL-Z: Undo the last operation (has extended memory)

CTRL-E: Toggle between Front Panel and Block Diagram

CTRL-B: Remove broken wires

CTRL-H: Enable context help (hover over components to get specific help)

NI LabVIEW Certification Program: A Resume Enhancer?



Exams cost $$$; student discounts available
Certification must be renewed every 2 years
Test site here in Albuquerque
Need many months of LabVIEW experience before attempting CLAD

ELECTRICAL SAFETY

According to US Dept of Labor:

- Over 30,000 non-fatal electrical shock accidents occur each year
- Over 600 people die from electrocution each year, plus thousands from electrically-caused fires
- Electrocution is the 4th highest cause of industrial fatalities
- Most injuries can be avoided

ELECTRICAL SAFETY

Electrical energy comes from:

* Power supplies, wall outlets
* Batteries, capacitors, inductors

Can cause:

Shock, burns, fires, explosions

It is known that ac voltage levels of around 50V can be lethal in certain conditions

Capacitor danger

Same essential physics as a carpet shock

Dangerous even when circuits are de-energized

All capacitors have a maximum voltage rating

Be especially careful with electrolytic capacitors: Polarity (+/-) is marked on device.

306L Lab Rules

Never work on circuits without someone else in the lab

Don't attempt the work if you are excessively tired

Double-check circuits before applying power

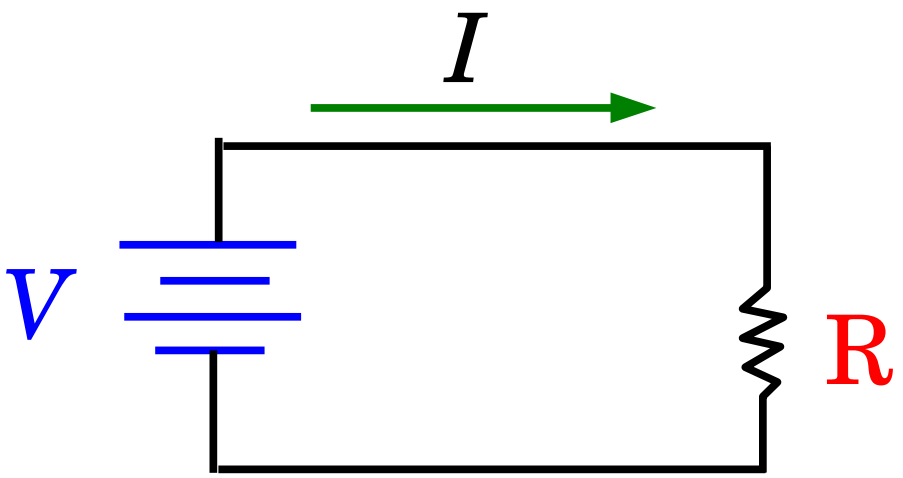
No food or drink allowed (we are guests here)

Know where the safety exits are

Know where the fire extinguishers are

If in doubt, please ask!

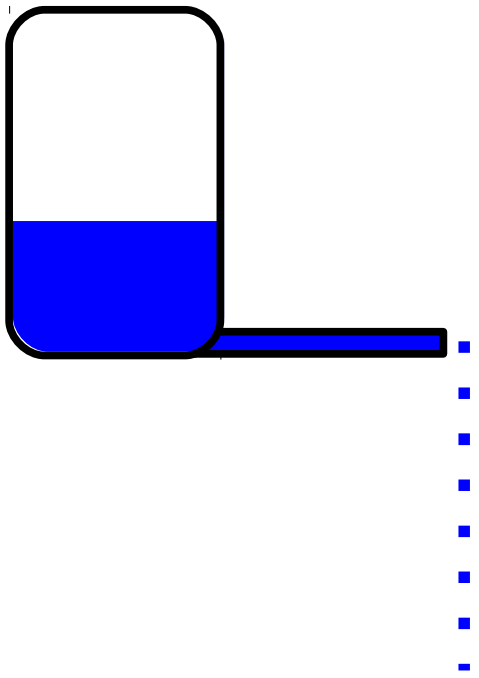
Ohm's Law



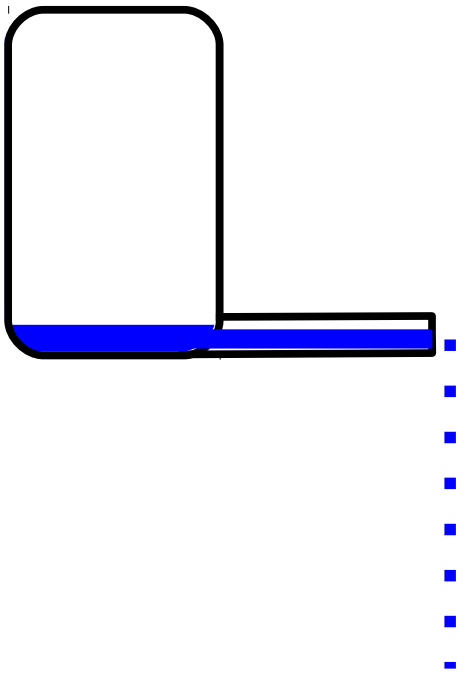
$$I = V/R$$

Georg Ohm (1789--1854)

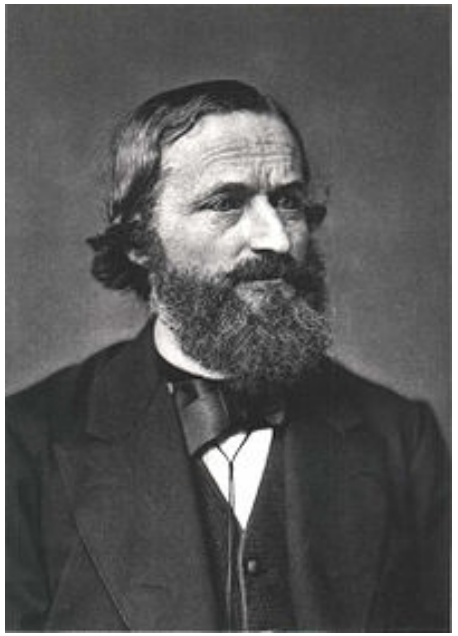
Ohm's Law: Flow Analogy



Higher potential
Smaller diameter



Lower potential
Larger diameter



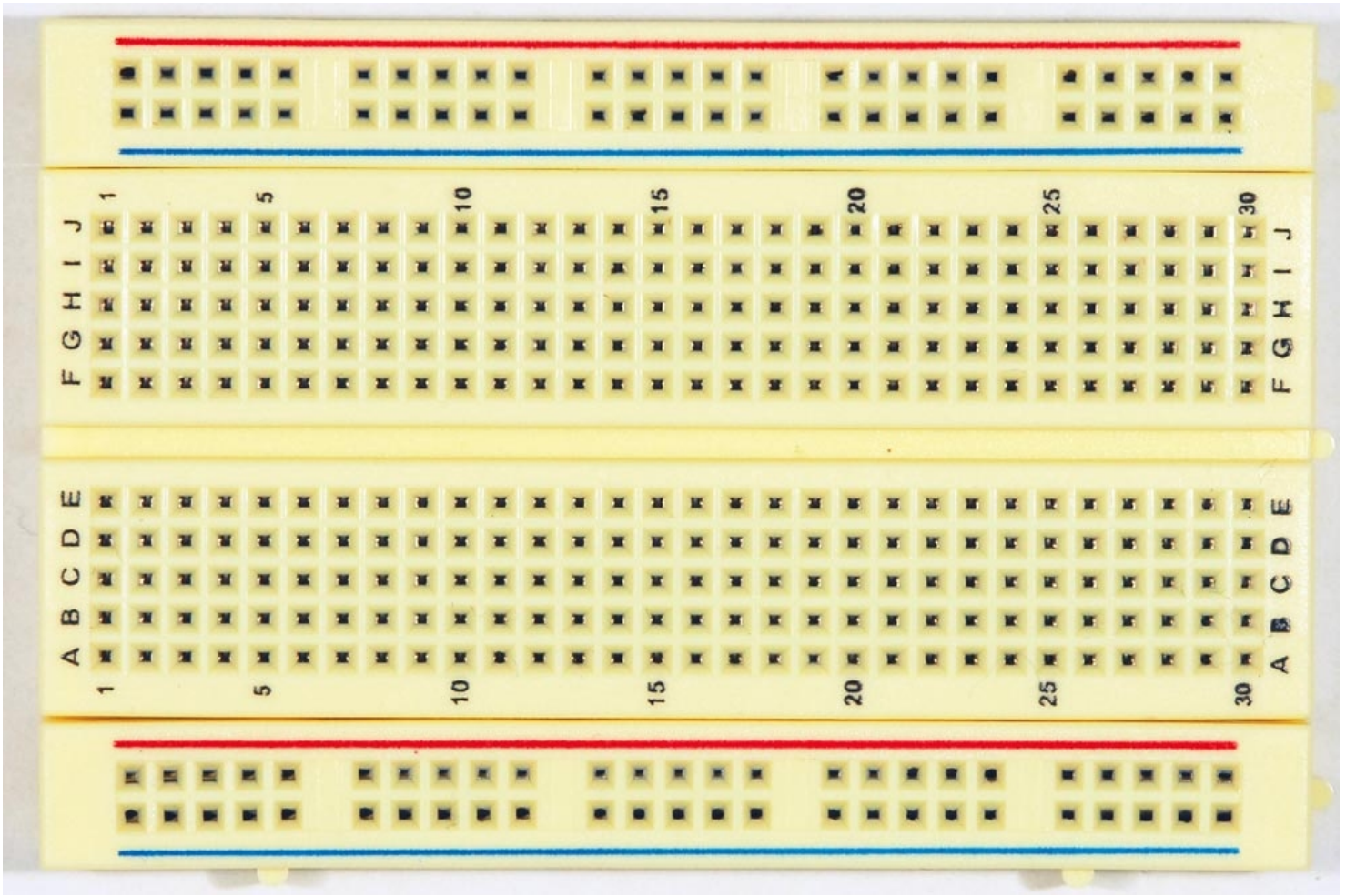
Gustav Kirchoff (1824—1887)

Kirchoff's Laws (1845)

Kirchoff's Current Law:
Sum of currents at a node is zero

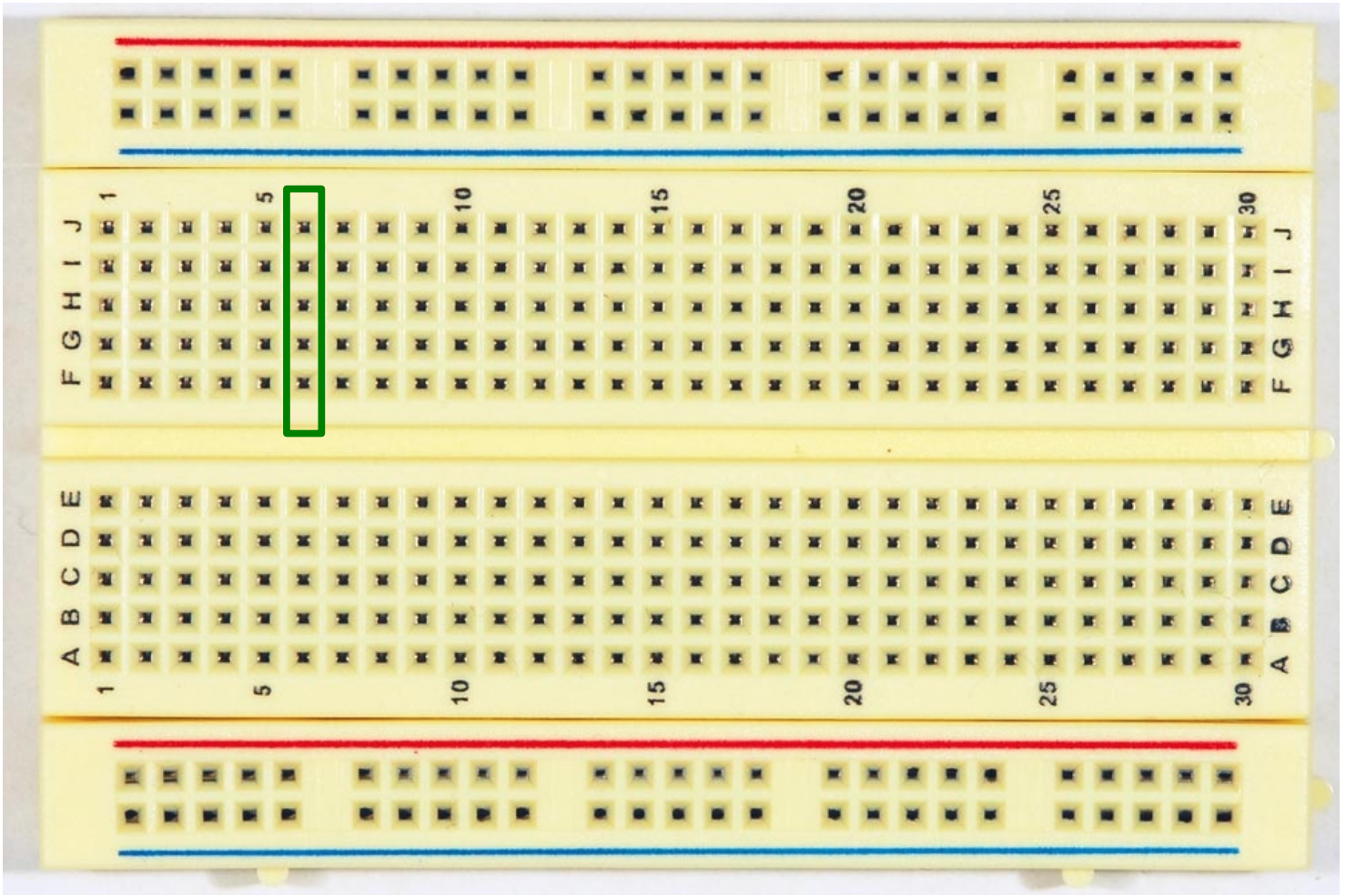
Kirchoff's Voltage Law:
Sum of potential drops around a closed loop is zero.

HOW TO USE THE BREADBOARD



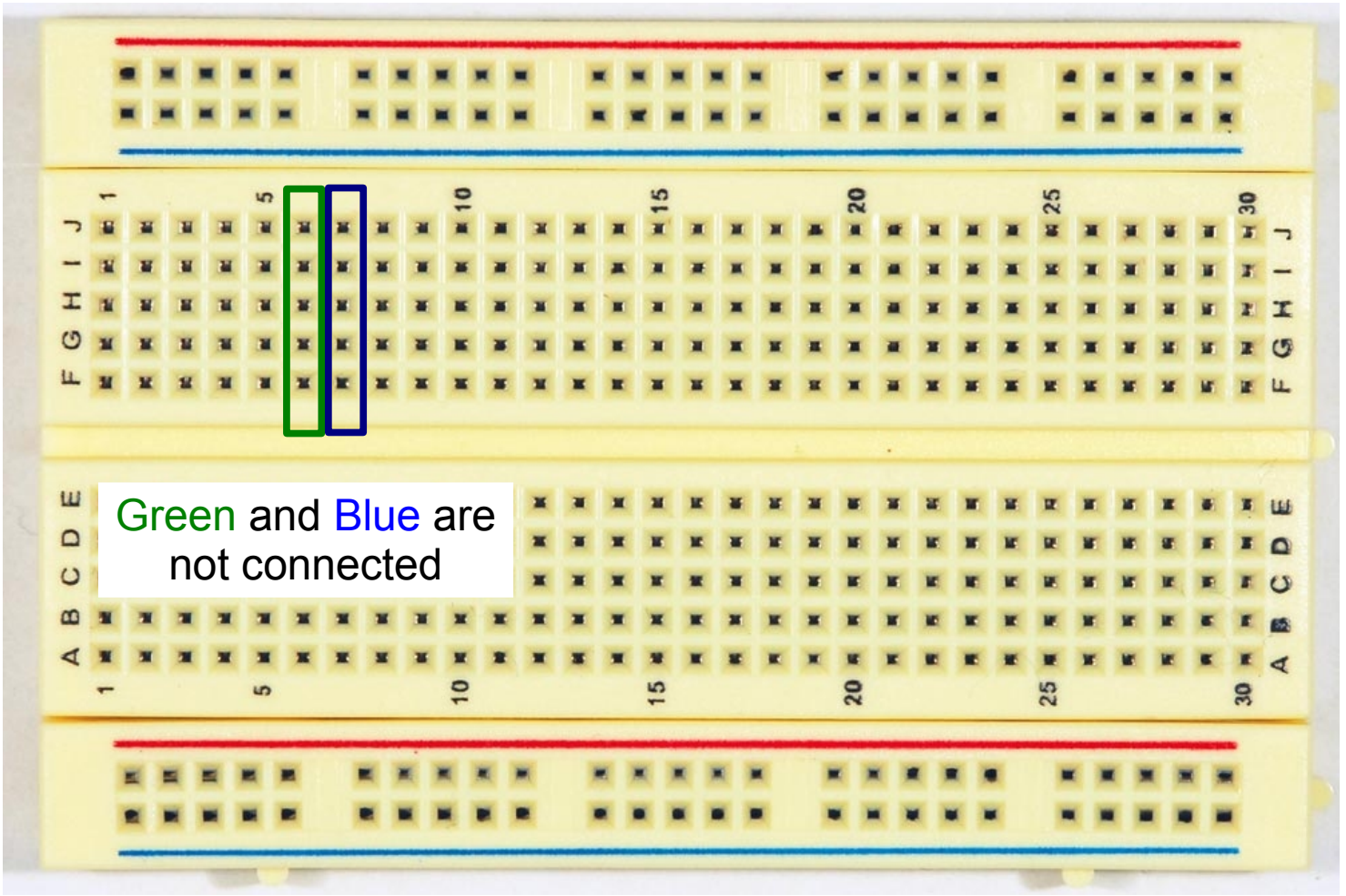
HOW TO USE THE BREADBOARD

Columns of 5 holes are connected



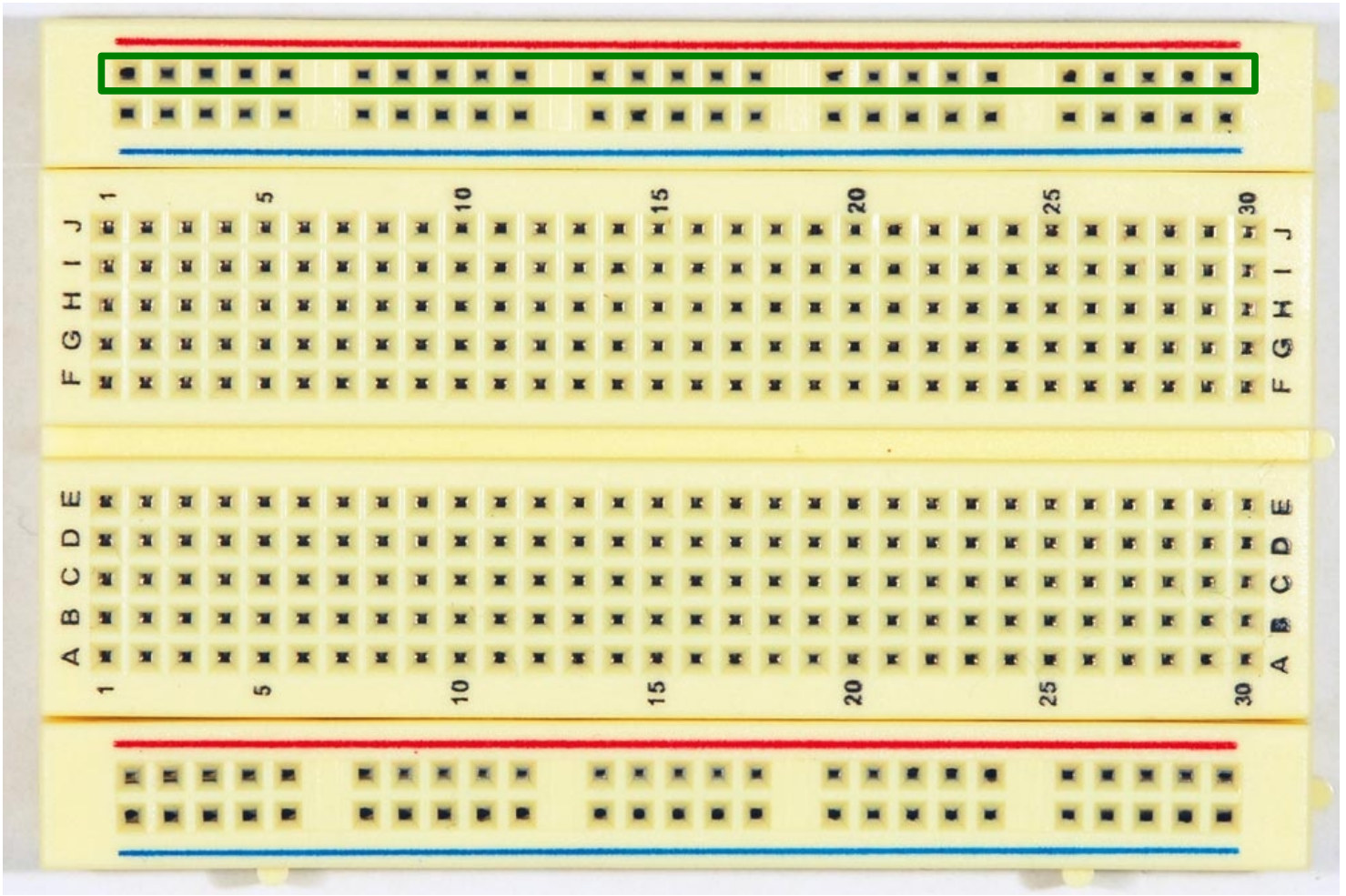
HOW TO USE THE BREADBOARD

Columns are all isolated from each other



HOW TO USE THE BREADBOARD

Rows adjacent to colored lines are all connected



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